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Slug (*Deroceras* sp.) as main disseminating vector of bud rot disease of coconut in southern India

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ABSTRACT

The common slug, *Deroceras* sp. found abundantly in the coconut gardens during the rainy season was observed as a major source of *Phytophthora* inoculum dispersal vector as its fecal matter contained abundant *Phytophthora* propagules which cause bud rot disease of coconut in southern states of India. This is the first report of the possible role of *Deroceras* sp. in the disease cycle as a vector disseminating *Phytophthora* propagules from India. Microscopic examination of fecal matters of the slugs collected from both healthy and diseased coconut gardens in disease-endemic areas revealed the presence of *Phytophthora* propagules in the feces of slugs.

KEY WORDS: Bud rot disease, *Cocos nucifera*, disseminating vector, slug

INTRODUCTION

The coconut palm (*Cocos nucifera* L.) "the symbol of tropics" is affected by several pest and diseases, among them, bud rot caused by *Phytophthora palmivora* is a major fatal disease in India. Sever bud rot disease incidence was reported in major coconut growing states of India, especially in some of the isolated pockets of Kerala and Karnataka states (Sharadraj and Mohanan 2013). It has been observed that the intensity of the disease is increasing year after year with the inoculum build up leading to heavy economic loss to the coconut growers in the endemic areas in southern parts of India.

The common slugs, *Deroceras* sp. which were very common in coconut gardens during the rainy season in South India, were found feeding on the fungal growth especially the fungal growth on rotting immature fallen nuts (Figure 1). They were found in the garden soil and also found moving along the trunk, especially along the area where the water flows down from the crown during the rainy season (Figure 2). Slugs and its feces were also observed in the leaf axils of the crown of palms. Microscopic examination of fecal matters of the slugs collected from different coconut gardens in disease-endemic areas revealed the presence of *Phytophthora* propagules in the feces of slugs (Figure 3). The presence of *Phytophthora* propagules in the feces was further confirmed by baiting it on healthy immature coconuts or young rachillae pieces and re-isolation of *Phytophthora* from the lesions developed.

Figure 1: Slug feeding *Phytophthora* growth on fallen immature nut

When the feces of 30 slugs collected from the trunk of healthy coconut palms of 20-25 years old were examined under a microscope, 10% of the slugs were found to be carriers of *Phytophthora* propagules. The feces of 10% of slugs also yielded *P. palmivora* when baited on coconut healthy tissue and re-isolated. Microscopic examination of feces of 21 slugs collected from fallen immature nuts with rotting symptoms from different gardens revealed the presence of *Phytophthora* propagules in the feces of

52.40% of slugs and *P. palmivora* could be isolated from the feces of 62% of slugs by baiting method. The slugs were very common in the leaf axils of coconut palms (Figure 4). *Phytophthora* propagules were found in the feces of slugs collected from leaf axils of bud rot affected

Figure 2: Slug moving on the moist part of the trunk toward crown

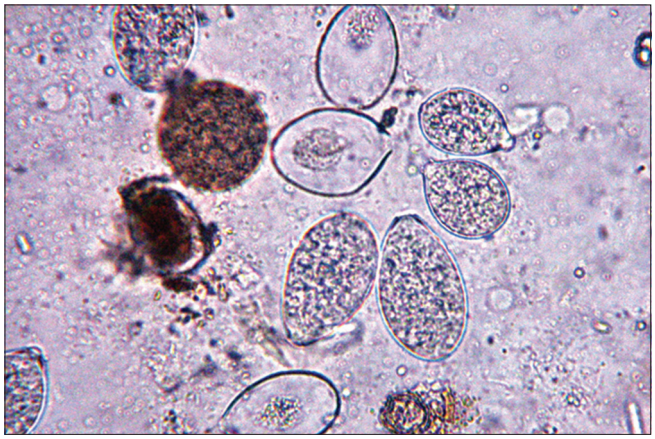

Figure 3: *Phytophthora* sporangia in the fecal matter of the slugs

Figure 4: Slug and its fecal matters in coconut leaf axils

25-30 years old coconut palms in different gardens. When feces of 30 slugs collected from leaf axils of coconut palms were examined microscopically, feces of 73.3% slugs showed the presence of *Phytophthora* propagules. *P. palmivora* was isolated from the fecal matter of 80% of the slugs collected from leaf axils of bud rot affected coconut palms.

Selective feeding habit was observed when live slugs were collected from coconut gardens without bud rot disease, and three such slugs were allowed to starve for 48 h under a clean bell jar; then they were taken out and released under another bell jar containing *P. palmivora* and *Trichoderma harzianum* cultures grown in carrot agar medium for 5 days. Even though, the slugs were released, after 2 days starvation; they were feeding only on *P. palmivora* culture and did not enter into the *T. harzianum* culture plate. Microscopic examination of the feces of these slugs also revealed the presence of sporangia, chlamydospore, and mycelial bits. Feces of all these slugs yielded *P. palmivora* on isolation by baiting method. This study indicated the possible role of *Deroceras* sp. as a dissemination vector of *Phytophthora* and thus it could be one of the sources of inoculum.

The common slug, *Deroceras* sp. found abundantly in the coconut gardens, palm trunk, crown, and feeding the fungal growth on fallen immature nuts during the rainy season was observed as a major source of inoculum dispersal as its fecal matter contained abundant *Phytophthora* propagules. This is the first report of the possible role of *Deroceras* sp. as a vector disseminating *Phytophthora* propagules. The preliminary observation of Iyer and Rasmi (2005) was the only study regarding the presence of *Phytophthora* propagules in the feces of slug, *Mariaella dussumieri* in coconut gardens reported from India. However, this slug was not found commonly occurring in coconut gardens such as *Deroceras* sp. Though detailed studies have not been conducted, the giant African snail, *Achatina fulica* was reported to disperse spores of *P. palmivora*, the causal organism of black pod disease of cocoa, through its feces (Borkakati *et al.*, 2009). During the survey of coconut garden in the southern states of India, the giant African snail was not observed in any of the gardens surveyed. However, there are reports of the occurrence of this snail in the southern part of India, that too in abundance in some localities. Considering the earlier reports on cocoa, in future, this snail may be expected to become a major dispersal vector of *Phytophthora* propagules in the coconut gardens through its feces. Transmission of *Phytophthora* species has also been reported for a number of insects such as Sciara flies (Murphy and McKay 1927),

Drosophila (Hunter and Buddenhagen, 1969), the weevil Scyphophorus interstitialis Gyll., and ants (Mc Gregor and Moxon, 1985; Newhook and Jackson, 1977; Okaisabor, 1974; Peregrine, 1969; Taylor and Griffin, 1981; Turner, 1972).

The preliminary studies conducted in other coconut growing countries indicated that insects, birds, slugs, snails, and even people could be sources of inoculum for the spread of *Phytophthora* diseases (Downer *et al*., 2009). It is very much imperative to consider slug as a disseminating vector when implementing an integrated disease management strategy to control the bud rot disease.

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